ICTMA Newsletter

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The International Community of Teachers of Mathematical Modelling and Applications.
www.ictma.net/

The Community, through its membership, research and other activities, is recognised as "The International Study Group for Mathematical Modelling and Applications (ICTMA)" by its affiliation to the International Commission on Mathematical Instruction (ICMI).

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Contents

Please send future contributions to the editor by email <g.stillman@unimelb.edu.au>. The next Newsletter will be published in August, 2008. We are interested in your contributions to any of the current sections.

1. International Executive Committee

The current ICTMA Executive is as follows:

President
Prof Gabriele Kaiser (Germany)
Past Conference Organisers
Prof Chris Haines (UK) – Secretary
Prof Richard Lesh (USA)
Elected Members
Toshikazu Ikeda (Japan) – Registrar
Thomas Lingefjärd (Sweden)
Gloria Stillman (Australia) – Newsletter Editor
Co-opted Members
Jonei Barbosa (Brazil)
Katja Maaß (Germany)
Bhadra Tuladhar (Nepal)
Jinxing Xie (China) – Webmaster & List Serve Moderator

2. ICME Affiliated Study Group Activities

At ICME 11 in Monterrey ICTMA members will have two sets of activities related to ICTMA that they can attend the Topic Study Group 21 organised by Morten Blomhøj and Susanna Carreira and the Affilitated Study Group Sessions. TSG21 is about Mathematical Applications and Modelling in the Teaching and Learning of mathematics. For details visit: http://tsg.icme11.org. There will also be sessions for ASG sessions. Two themes are planned for the ASG sessions:

Theoretical perspectives and joint research perspectives.

More details will follow as soon as we have replies from the Mexico orgainsers.

3. Forthcoming ICTMA Conferences

The ICTMA group has held biennial meetings since 1983. This conference series provides a forum for discussing all aspects of teaching applications and mathematical modelling in all areas and at all levels of mathematics education – from primary to secondary schools, at colleges and universities. The next two ICTMA Biennial conferences will be ICTMA 14 in Hamburg in 2009 and ICTMA 15 in Melbourne in 2011.

14TH INTERNATIONAL CONFERENCE ON THE TEACHING OF MATHEMATICAL MODELLING AND APPLICATIONS (ICTMA14)

The 14th ICTMA Conference - ICTMA14 - will be held at the University of Hamburg and organised by the Faculty of Education, Working group on didactics of mathematics. It will be chaired by Professor Gabriele Kaiser. The conference is scheduled from

Monday, 27th July to Friday, 31st July 2009

Academic programme:

A variety of activities is planned, covering plenary lectures, paper presentations and working groups. The following issues will be tackled:

(i) Pedagogical issues, such as the understanding of modelling, promotion of modelling competencies, cognitive aspects;

(ii) Assessment of modelling activities in school and universities;

(iii) Connections to industrial or commercial practice, mathematics at the workplace;

(iv) Influences of technology;

(v) Cross-cultural aspects and international studies.

Conference venue:

The conference will take place in the building of the Faculty of Education at the university's Campus Von-Melle-Park. The Campus is situated near Lake Alster in the very heart of Hamburg.

Conference fee:

The conference fee will be approximately 400 € with a possible reduction for young researchers and will include various events, such as a guided city excursion, conference dinner, snacks and lunch and a hardcopy of the conference proceedings.

Social programme and accommodation:

There will be a strong social programme for participants, and a complementary programme for accompanying persons. Participants can also arrange pre- and post-conference tours to Germany's new capital Berlin.

A great variety of hotels and cheaper accommodation are in walking distance.

The City:

The "Freie und Hansestadt Hamburg", Germany`s second biggest metropolis (1.8 million inhabitants) is a bustling, cosmopolitan port city. Hamburg is situated between the North Sea and the Baltic Sea and easily reachable by its internationally connected airport. The Lake Alster together with the Elbe river, numerous canals and parks adjoining them, have made Hamburg well-known as a "green" metropolis at the water's edge.

The University:

The University of Hamburg is a state university of the "Freie und Hansestadt Hamburg". Hamburg's view of itself as "gateway to the world" is reflected by the university's diversity of scientific areas and educational possibilities and thus it presents itself as "gateway to the world of knowledge". 38,700 students are inscribed at the University of Hamburg and 851 professors are engaged in teaching and research.

Transport

Hamburg is situated between the North Sea and the Baltic Sea and easily reachable by its internationally connected airport.

For further information, please email to the conference secretary Karen Stadtlander:

stadtlander@erzwiss.uni-hamburg.de

or see the website of Prof. Gabriele Kaiser: http://www.erzwiss.uni-hamburg.de/Personal/Gkaiser/

4. Brief News Items

4.1 The History of ICTMA – The First Twenty-Five Years

As part of the Centennial celebrations of ICMI in 2008, ICTMA has been asked to prepare a history. This has been published on the website of the ICMI Centennial Symposium at http://www.icmihistory.unito.it/group.php

4.2 Funding Received for DQME II Project from European Union

In March a group of researchers and educators from eleven other countries in Europe met in Dortmund for a week to write an application for a large three year EU project. In early September the team received the news from EU that the project was funded. The project is about teaching mathematical modeling in the gymnasium (high school) and taking video shots of excellent events, editing and putting English subtitles on the video, and publishing it on the web. There is also an exchange part concerning teachers and pupils that is very interesting. There will also be a research part regarding general ideas of teaching, learning and assessing mathematical modelling. See the full report from Thomas Lingefjärd in the Project Reports section.

4.3 Appeal for more Subscribers to NOMAD

NOMAD (*Nordic Studies in Mathematics Education*) is a journal for research and developmental work in mathematics education. It addresses all who are interested in following the progress of this field in the Nordic countries, Denmark, Finland, Iceland, Norway and Sweden. The most important aim of the journal is to stimulate, support and foster Nordic researchers and post-graduate students in mathematics education and to develop mathematics teaching and teacher-education in theory and practice at all levels of the educational system. Abstracts of articles can be accessed at http://ncm.gu.se/node/959. The editors are Morten Blomhøj of Roskilde University, Denmark and Paola Valero, Aalborg University, Denmark. The journal often contains articles or reviews about modelling and real world applications in mathematics and so is recommended to ICTMA members and the libraries of their institutions. A membership of the Association of Nordisk matematikk-didaktikk with a subscription of Nordic Studies in Mathematics Education, Nomad (ISSN 1104-2176) including 4 issues annually. There are different rates for institutions, individuals and students. Details of how to order are available from the NCM website http://ncm.gu.se/.

4.4 Invitation to Write for The Teaching of Mathematics

The Teaching of Mathematics is published by the Mathematical Society of Serbia. T *The Teaching of Mathematics* started as a separate volume of *Nastava matematike*, a pedagogical journal in Serbian, which has been edited since 1952.

"The Teaching" is exclusively research oriented. All contributed papers containing essentially new ideas and techniques relevant for teaching of mathematics at all levels, recommended by our refrees, will be considered for publications. In particular, the papers containing subject analysis of selected teaching themes and new ways of their modelling will be welcomed. The editors are Milosav Marjanovi and Zoran Kadelburg, both of University of Belgrade, Serbia.

The languages of this Journal are the congress languages of the International Mathematical Union. The journal can be accessed through the web site http://elib.mi.sanu.ac.yu (free access) and contributions can be submitted in English, French, German or Russian, with an abstract in English. Hope you will find time to write a paper on mathematical modelling for the Journal.

4.5 Logo and Revising of the Website Interface

In this newsletter we unveil our first logo. The curve incorporated into the ICTMA acronym is the logistic curve which is a model used in population modeling. The logo design was made by Dr. Helen Chick of the University of Melbourne. We are also in the process of redesigning the website which will be carried out by our webmaster, jinxing Xie, in the near future.

5. Reports from Regional Areas

5.1 MAPPING OF MATHEMATICAL MODELLING IN BRAZILIAN EDUCATION

The international movements concerning mathematical modeling in teaching have also influenced Brazil practically at the same time, with the collaboration of Brazilian educators representing the country in the international academic community involved in Mathematics Education. In the momentary impossibility of knowing who all the Brazilian precursors were in the use of modeling or in the construction of models in their activities in the classroom, I would like to register three singular people that I consider to be fundamental to the impulse and consolidation of mathematical modeling in Brazilian education: Aristides Camargo Barreto, enthusiast in mathematical modeling in music, who used modeling in his undergraduate classes at PUC-RJ, Rio de Janeiro-RJ and who, beginning in the 1970's, represented Brazil at various International Congresses, such as ICME III and ICME IV and supervised the first Master's degree thesis in 1976 - *Models in Learning Mathematics* written by Celso Braga Wilmer; Ubiratan D'Ambrosio, Brazilian representative to the international community of Mathematics Education who in the 70's and 80's developed courses and coordinated projects at the University of Campinas(SP) – UNICAMP that led to the formation of groups in applied mathematics, bio-mathematics and modeling; and Rodney Carlos Bassanezi, who besides taking part in these same courses and projects at UNICAMP, became the principle disseminator of mathematical modeling in Brazil since, after adopting it into his classroom practices (undergraduate, related and specific post-graduate and continuing education courses) won over a significant number of disciples throughout Brazil. I belong to the first generations of Bassanezi. Ever since I heard him for the first time in 1986, I have dedicated myself to the research and teaching of mathematical modeling.

Currently, the amount of research and reports of classroom experiences presented at Mathematics Education events (regional, statewide and national) and at the National Modeling Congress (held on a biennial basis since 1999) has increased significantly, along with the number of teachers who have become interested in the subject through extension and post-graduate courses and publications. Furthermore, various undergraduate courses for mathematics teachers have sought to include modeling in teaching in their course curricula as either a discipline or as part of the overall discipline known as Teaching Methodology of Mathematics. As of now, I have identified 11 doctoral dissertations, 76 masters' theses, 105 post-graduate monographs on related themes; 27 undergraduate monographs made at the conclusion of the course, and various scientific initiatives. In addition, I have located 503 articles published in Annals of Events (416) and in Academic journals (87). I have also verified that 35 undergraduate courses for mathematics teachers included Modeling in Teaching in their course curricula and 47 post-graduate courses that do so. This list does not include the thousands of works supervised by teachers in their modeling disciplines in undergraduate courses or in primary and middle schools. In addition, three books have been published: *Mathematical Modeling & Implications in Teaching and Learning*, first edition 1999, second in 2003; *Modeling in Teaching* first edition in 2000, now in its 5th edition (both by myself), and the third, *Mathematical Modeling in Teaching-Learning* by Bassanezi, published in 2002. The objective of the first two books was to clarify the concept of modeling in teaching and the methodological bases of classroom practices for Primary and Middle School teachers, presenting some works as proposals for teaching.

Brazil with an area of 8.5 million km^2 is divided into 26 states, with a population of about 180 million. Its national language is Portuguese. It has the following educational institutions: 2,013 universities and colleges; 186,000 schools (primary to secondary), with a total of 47 million students. Considering the geographic and demographic size of Brazil, the level of production on *Mathematical Modelling in Teaching* is small but is growing significantly. This mapping, begun in 2003, led me to create the *Reference Centre for Mathematical Modelling in Teaching*. My purpose continues to be the *mapping of pedagogical activities of mathematics educators* who had/have some knowledge about Mathematical Modeling and its use in teaching.

Maria Salett Biembengut, salett@furb.br University Regional of Blumenau – FURB, BRAZIL

5.2 CREMM - Reference Centre for Mathematical Modelling in Teaching (www.furb.br/cremm)

CREMM started to function in October 2006. The site is in three languages: English, Spanish and Portuguese. The principal purposes of CREMM are: to be a Research Centre with international cooperation; to make available a wide range of materials relevant to the area: Books, Academic Work (Monographs, Theses and Dissertations) and Articles in Journals and Reviews; to make available on-line a summary of the material and respective authors for the purpose of consulting and/or requests for guidance; to provide on-line supervision of students and guidance for professors and researchers (whether they are involved in teaching or pure research); to create didactic support materials for various levels of education and to make them available to interested teachers, with the support of associated research professors; to promote seminars and courses, both in person and at a distance; to publish informative bulletins and to edit a specialised journal; to publish books with the results of work developed by collaborating research professors (or members of the group); to contain links with information relevant to conferences, research groups, courses and announcements related to the area of Mathematical Modelling in Teaching. In the first year, we identified and acquired the Brazilian production that will appear on the CREMM website. We expect to make this production available shortly. In order to consolidate CREMM, we relied on several research professors; the Regional University of Blumenau has also supported us completely. CREMM inhabits a physical space of 90 m^2, composed of 6 areas, which include: library with a collection on modelling; study, meeting and support rooms; kitchen and bathroom. Assisting in the work are 10 undergraduate students, 2 Masters' students and the coordinating staff (Maria Salett Biembengut, Emilia Melo Vieira and Nelson Henn). Next year, we will seek out academic production from other countries and will start a Distance Learning Course. As such, we ask for your collaboration in sending us any type of information about Modelling in Teaching. CREMM belongs to the entire community of educators, students and people interested in Modelling.

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5.3 Report on Modelling Meeting held in Brazil

Between November 8th and 10th, 2007, the 5th National Conference on Modelling in Mathematics Education (5th CNMEM), was held in the Brazilian city of Ouro Preto. This event gathered around 350 participants from all parts of Brazil and this year it was organized by the Federal University of Ouro Preto and the Federal University of Minas Gerais.

The event's programming was carried out in the form of round tables and workshops, which dealt with classroom practices, social-critical aspects, teacher training and ethnomathematical relations among other subjects. In addition, researchers and teachers were able to present research and experiencial reports through brief interchanges. All the event's activities were centered around the general theme: mathematical modelling in different social practices.

For the opening of the conference, we were graced with the presence of Professor Gabriele Kaiser, president of the International Study Group for Mathematical Modelling and Applications, who presented the international debate on Modelling perspectives. The presence of Professor Kaiser was a fundamental element towards strengthening the link between the Brazilian and international modelling communities.

Along with the event's proceedings, there was also a book launch organized by the Working Group on Mathematical Modelling of the Brazilian Society for Mathematics Education which brought together 15 chapters produced by researchers from different institutions. This work offers a panorama of the debate on Modelling throughout Brazil.

In its fifth edition, we can affirm that the CNMEM has become consolidated as part of the Brazilian Mathematics Education calendar. The idea for such an event originated in 1999, after the participation of a group of Brazilians in the 9th International Conference on the Teaching of Mathematical Modelling and Applications (ICTMA9), in Lisbon, which served as inspiration. The first edition of the CNMEM happened in this same year (1999), after which the following editions regularly took place biennially.

With the gaining of experience over time, it was able to improve the organisation of the CNMEM, so that by 2007, a well structured event had come into being: the separation between the local organisational committee and the national scientific committee, the publication of proceedings and clear mechanisms to select the papers to be presented among other considerations. The national organisation of the event has involved the Working Group on Modelling of the Brazilian Society for Mathematics Education, which chooses the scientific committee and discusses other topics with the local committee.

The National Conferences have had an important role for the modelling movement in Brazil, mobilising teachers, future teachers and researchers, and creating the space for interchange as well as making viable the publication of classroom and research reports. Presently, we are already preparing for the next edition of the CNMEM at the State University of Londrina.

Jonei Cerqueira Barbosa, Coordinator of Working Group on Mathematical Modelling of Brazilian Society for Mathematics Education, State University of Feira de Santana

6. Project Reports

6.1 Authentic Contexts in Mathematics Textbooks for the Vocational Stream

The purpose of this project was to evaluate the use of real-world contexts in modelling exercises in Dutch mathematics textbooks for grades 9 and 10 of the vocational streams in Dutch secondary education. The textbooks were used under the current applications-based curriculum. The authors developed a framework for authenticity in tasks:

1. Geared towards the world, in which the students live (empathise, identify).

2. Relevant and meaningful in out-of-school situations.

3. Enabling the construction of knowledge within a complex task situation, whereby students can develop their own methods to solve the problem.

4. In maximal accordance with reality of future professional practice (technical, agronomical, administrative, nursing).

In this study, the research team took a sample of tasks and developed a procedure to reliably score each task on authenticity characteristics. Results show that Dutch students in the vocational streams encounter a large number of context-based tasks with a low degree of authenticity in their mathematics textbooks. The study concludes with recommendations on the improvement of tasks towards more authenticity.

Research Publication from project:

Wijers, M., Jonker, V., & Kemme, S. (2004). Authentieke contexten in wiskundemethoden in het vmbo [Authentic contexts in mathematics textbooks for the vocational stream]. *Tijdschrift voor Didactiek der Bètawetenschappen*, 22(1), 1-19.

6.2 Mathematical Literacy according to PISA; Which Way does the Wind Blow?

The Netherlands did well in the international comparative Pisa study. In this report, the authors analyse the Dutch results in the 2003 Pisa study beyond the mere country rankings and points score. It turns out that different aspects contributed to the high Dutch score. Dutch students perform well on the category of Reproduction, but relatively less so on Making Connections or Reflections. Dutch students perform well on interpreting diagrams and on probalistic reasoning, but relatively less well on multistep problems and on exercises with formal notations. The weaker students in the Netherlands (in the vmbo stream) do very well compared to their counterparts elsewhere.

Research Publications from project:

Dekker, T., Lagerwaard, K., de Lange, J., Limpens, G. & Wijers, M. (2006). *Wiskundige geletterdheid volgens Pisa; hoe staat de vlag erbij? Volume 1: Analyse. Volume 2:Opgaven [Mathematical literacy according to Pisa; which way does the wind blow? Volume 1: Analysis.Volume 2: Tasks].* Utrecht, NL: Freudenthal Institute, Utrecht University.

6.3 RITEMATHS—Enhancing Mathematics Achievement and Engagement by using Technology to Support Real Problem Solving and Lessons of High Cognitive Demand

RITEMATHS is an Australian research project of the University of Melbourne and the University of Ballarat. It was financially supported by the Australian Research Council, through the Linkage Grant Scheme for 2004-2006 and seven industry partners. Data collection was completed in 2006 but analysis and writing has continued in 2007.

The RITEMATHS research team consisted of Chief Investigators: Prof Kaye Stacey, Dr Gloria Stillman, (University of Melbourne), Dr Robyn Pierce (University of Ballarat), and PhD candidate with Australian Post-graduate Award (Industry), Jill Brown, University of Melbourne, together with Sandra Herbert, University of Ballarat and a visiting Researcher: Dr Caroline BARDINI, European Union. Adjunct Prof Peter Galbraith of the University of Queensland has also been involved. Industry Partners were Texas Instruments Australia Pty Ltd, Ballarat Secondary College, Canterbury Girls Secondary College, Luther College, Mount Clear College, Santa Maria College, Westbourne Grammar School.

With the school industry partners, the research team created and implemented a curriculum that used technology to link mathematics to the real world for the middle secondary years, mainly in Years 9 and 10. This project attempted to engineer an innovative educational environment. Partner-teachers created new learning environments that worked in their own school settings incorporating new approaches and technology. The mathematical focus was change and variation, a general theme which underpins much of the curriculum but most especially algebra. Two types of hot-linked software were used together:

- Real-world interfaces which included software enabling analysis of digital photos and video (e.g. GridPic, Vidshell), and dynamic control of simulations (e.g. SIMCALC).
- Maths analysis tools (e.g., spreadsheets, data plotters, function graphing software, and computer algebra systems (CAS), on both calculators and computers) which work with abstract mathematical representations and raw data.

The broad aim of this project was to discover the most effective ways to use technology to stimulate higher-order thinking in mathematics classrooms, in the context of using real world problems. There were three main research areas:

- *Context Theme.* Can we use new technology to overcome some of the obstacles inherent in using real-world problems?
- *Algebra theme.* How can CAS enhance what can be done with real problem solving in ordinary school settings? Can learning algebra through real world problem situations provide more meaning for algebraic concepts?
- *Affordances theme.* How do various features of technology assist students to use their insights from real world situations to support abstract thinking?

Throughout the project, the RITEMATHS team attempted to equip a large team of teachers from partner schools with practical and theoretical knowledge to design mathematical tasks that promoted deeper learning and engagement of students in higher-order thinking than previously.

Selected Research Publications from project:

Bardini, C., Pierce, R., & Stacey, K. (2004). Teaching linear functions in context with graphics calculators: Students' responses and the impact of the approach on their use of algebraic symbols. *International Journal of Science and Mathematics Education, 2*(3), 353 - 376.

Galbraith, P., & Stillman, G. (2006). A framework for identifying student blockages during transitions in the modelling process. *Zentralblatt für Didaktik der Mathematik*, 38(2) 143-162.

Galbraith, P. L., Stillman, G. A., & Brown, J. P. (2006). Identifying key transition activities for enhanced engagement in mathematical modelling, In P. Grottenboer, R. Zevenbergen, & M. Chinnappan (Eds.), *Identities, cultures and learning spaces*, Proceedings of the Twenty Ninth Annual Conference of the Mathematics Education Research Group of Australasia Incorporated, Canberra, pp. 237-245. Adelaide, Australia: MERGA.

Galbraith, P., Stillman, G., Brown, J., & Edwards, I. (2007). Facilitating middle secondary modelling competencies. In C. Haines, P., Galbraith, W., Blum, & S. Khan (Eds.), *Mathematical modelling (ICTMA12): Education, engineering and economics (pp. 130-140).* Chichester, UK: Horwood Press.

Pierce, R., Stacey, K., & Barkatsas. A. (2007). A scale for monitoring students' attitudes to learning mathematics with technology. *Computers & Education, 48* (2), 285-300.

Stillman, G. (2006). The role of challenge in engaging lower secondary students in investigating real world tasks. In E. Barbeau & P. Taylor (Eds.), *Proceedings of the ICMI Study 16: Mathematical Challenges in and Beyond the Classroom*, *Trondheim, Norway,* eds. 8pp. Pre-Conference papers available at ICMI Study 16 website: http://www.amt.edu.au/icmis16.html

Stillman, G., & Brown, J. (2007). Challenges in formulating an extended modelling task at Year 9. In H. Reeves, K. Milton & T. Spencer (Eds.), *Mathematics: Essential for learning, essential for life*, Proceedings of the twenty-first biennial conference of the Australian Association of Mathematics Teachers (AAMT) (pp. 224-231). AAMT, Adelaide: AAMT.

Stillman, G., Brown, J., & Galbraith, P. (2007). Identifying challenges within transition phases of mathematical modelling activity at Year 9. Paper presented at the *Thirteenth International Conference on The Teaching of Mathematical Modelling and Applications* held at Bloomington, IN, USA. 10pp. [available http://site.educ.indiana.edu/Papers/tabid/5320/Default.aspx]

Stillman, G., Galbraith, P., Brown, J., & Edwards, I. (2007). A framework for success in implementing mathematical modelling in the secondary classroom. In J. Watson & K. Beswick (Eds.), *Mathematics: Essential research, essential practice.* Proceedings of the 30th annual conference of the Mathematics Research Group of Australasia (MERGA) (Vol. 2, pp. 688-707). Adelaide: MERGA.

For more information visit the RITEMATHS Web site (University of Melbourne): http://extranet.edfac.unimelb.edu.au/DSME/RITEMATHS/

6.4 DQME II—Developing Quality in Mathematics Education II

Background: In January 29, 2007 there was an invitation by e-mail from Hans-Wolfgang Henn in Dortmund:

Dear Friends,

Since almost three years, my colleagues and I are co-ordinating the Comenius project "Developing quality in mathematics education" (Comenius 2.1). The project will be finished by the end of September, 2007. For quite some time we are planning a follow-up network project in order to develop and spread our results further within a larger European network. We would like to enlarge the project to at least 10 different participating European countries. The current project partners from Germany, Great Britain, Poland and Hungary plan to continue their engagement. You are cordially invited to join our network project. The ideal setting for the national project partners consists of one or two schools (lower or upper secondary level) and a teacher education institution such as your university.

There are of course many different research projects within the European Union. Most well known is perhaps EU's Frame Program for research. Right now we are in FP 7, with duration between 2007 and 2013. In educational research we have Socrates which now is switching name to Lifelong Learning and within we find

COMENIUS – School education

ERASMUS – Higher education

GRUNDTVIG – Adult education and alternative educational approaches

Important for all projects within different EU programs are to promote the development of Europe. The projects are intended to give an extra dimension to the work one already does and the projects should be beneficial for as large part of Europe as possible. Many participating countries, everybody contributes to the financing and dissemination is important.

The project Developing Quality in Mathematics Education II (DQME II) is a collaborative project between 12 European countries within Comenius. Gothenburg University is the Swedish representative and every national university has the right to bring two partner schools to the project.

The project is quite unique in the sense that over 30 researchers, teacher trainers, and teachers met for five days in March 2007 in Dortmund, Germany, for a mutual attempt to author a common project definition across Europe: from Italy in the south to Sweden in the north, from Rumania in the east to England in the west. Participating countries are Austria, Czech Republic, Denmark, England, Germany, Holland, Hungary, Italy, Poland, Rumania, Slovakia, and Sweden.

The project aims to develop and show excellent teaching and learning ideas in mathematics at the upper secondary level. Every country should create good examples of mathematical modelling tasks and take video clips of the teaching, of communication, and of the students' demonstration of how they solved the problem. The video clips will be provided with English sub-titles and all materials will be translated into English. The project will also encourage teacher and pupil exchange between the European countries.

Time	Activity	Focus
November 14	First meeting of the research group Bratislava	**DQME II Research Group** Development of Assessment tools Development, Reflection and Evaluation of quality Criteria for learning material
November 15 - 18	First meeting of the whole project group Bratislava	Development, Reflection and Evaluation of quality Criteria for teaching methods Clarification of planning program for the dissemination of materials, results and ideas during the period 2008-2010. Allocation of dissemination tasks for partner teachers and teacher trainers in member countries at courses, workshops and meetings throughout 2007-8. Preparation for dissemination of materials, internet and communication platform. Planning of feedback evaluation and publication through the period 2008-2010.

Thomas Lingefjärd is responsible for the project DQME II in Sweden and he is also part of the research group within the project.

7. Recent Dissertations

Andresen, M. (2006). *Taking advantage of computer use for increased flexibility of mathematical conceptions.* PhD Thesis. Danish University of Education. ISBN 877684069-7. Supervisor: Prof. PhD Morten Blomhøj, Roskilde University.

This thesis reports on a teaching experiment with the aim to introduce the use of Computer Algebra Systems in upper secondary school mathematics. The research project was closely connected with a six-year running development project titled 'World Class Math and Science'. In this part of the project, the students had their own laptops all three years, with the software 'Derive'. The teachers were supposed to produce one piece of teaching materials suitable for teaching with the laptops, but for the rest they were only restricted by the usual formal requests. The teachers and groups of students were interviewed yearly about issues like working style, learning outcome, students' strategies and about the introduction of new subjects and new perspectives on the subjects taught.

The PhD project was a qualitative based study that aimed to extract certain experiences of generally improved learning, which some of the teachers and students who participated in the developmental project had recognised and reported in the interviews. Theory development had its foundation in these experiences.

Data from the study consists of teaching materials, students' reports and films and field notes from about 50 lessons in four different classes, where the laptops were used to introduce differential equations from a modelling perspective, in contrast with the traditional approach (Andresen, 2007b).

The main result of the project was my construction of the conceptual tool *flexibility* (Andresen, 2007a). Flexibility concerns the ability to change between different perspectives on a mathematical conception and between different representations of it. Some of the perspectives encompassed by this specific notion of flexibility are closely related to modelling, both to the level of applications and at the level of concept formation (Andresen, 2007c).

Subsequently, flexibility was tried out as a conceptual tool for analysis of students' activities and for interpretation and discussion of the conceptual development following from their activities. On this base, guidelines were prepared for teachers in their design of teaching sequences which aim to realise some of the potentials of computer use.

Bakker, A (2004). *Design research in statistics education: On symbolizing and computer tools*. PhD Thesis Utrecht University. Utrecht: CD-□ Press.

The present knowledge society requires statistical literacy-the ability to interpret, critically evaluate, and communicate about statistical information and messages (Gal, 2002). However, research shows that students generally do not gain satisfactory statistical understanding. The research presented in this thesis is a sequel to design research carried out by Cobb, McClain, and Gravemeijer (2003) and aims at contributing to an empirically grounded instruction theory for early statistics education in which educational computer tools are used.

Bronkhorst, H. (2006). *Logica in de bovenbouw van het vwo [Logics in the pre-university stream].* Masters Thesis. Groningen University. [Available from: http://scriptie.hugobronkhorst.nl/]

Bronkhorst carried out a design-based study, in which he developed lessons on Logic for his grade 10 students in the Humanities stream. His assumption was, that the topic of Logic as part of Mathematics would appeal in particular to students with linguistic talents. The aim was, to achieve the development of the concepts of *implication* and *modus ponens* (if A then B means: not A or B) by starting with reasoning tasks in concrete situations (games, cartoons, puzzles and other applications) and by postponing the use of truth tables. After an extensive baseline study, consulting many experts on the teaching of Logic, a series of lessons was developed. The evaluation was carried out through observation reports, a questionnaire on motivation, and interviews with selected students. In the course of the eight lessons the students displayed a talent for verbal reasoning, but towards the end some recoiled at the use of symbols, while others were challenged by the symbols. Students' eagerness to work on classroom tasks and on homework was higher than in regular mathematics lessons. The cognitive growth was measured through a pre- and posttest, which showed a substantial

development in logical reasoning. Bronkhorst observed that the topic of Logic has a great potential for this target group but recommends that more time is needed to develop abstract concepts.

Devesse, T.G. (2004). *Exploring the potentials of locally produced artcraft objects in teaching secondary school geometry in Mozambique*. Unpublished MEd Thesis. Maputo, Mozambique: University Eduardo Mondlane. Supervisor: Pauline Vos.

In this study, authentic resources were used as a starting point for mathematics, whereby *authenticity* was defined as 'clearly not produced for educational purposes'. The study focused on how locally produced art craft objects by traditional artisans (fish traps, baskets, rondavel roofs, etc.) can be used as opening for learner-centered geometry classes. This design-based research was conducted in Mozambique. It identified traditional objects that matched with curriculum topics and used an intervention, based on an instructional design model for developing educational materials. Traditional objects were collected at local markets, from the Museum of Natural History (Maputo) and from rural artisans. The prototype lesson materials were formatively evaluated against criteria of *validity*, *practicability* and *efficiency* (Nieveen, 1999), in a cyclic approach. The cycles were subsequently: an expert appraisal, a pilot with 5 students, an intervention with a half-size class (25 students, grade 10) at a secondary school in Maputo, and finally an intervention with a full size class (50 students, grade 10) at another secondary school in Maputo. The summative evaluation showed that the materials were even useful in an overcrowded classroom. The design promoted learner-centeredness through the use of worksheets with open-ended questions, group work, and manipulatives. The evaluation showed that traditional objects can be more than demonstrative tools, which are held up high by the teacher in front of the class. Before, students had received calculations on volume of a cone as an algebraic exercise (given r = 5cm, h = 7cm, what is the volume?), but now the volume made sense as the litres of river water contained in the fish trap. Students were highly motivated, because their cultural heritage was integrated into their education.

Doorman, L.M. (2005). *Modelling motion: from trace graphs to instantaneous change*. PhD Thesis. Utrecht University. Utrecht: CD-□ Press.

The goal of this design research project was to find out how students can learn the basic principles of calculus and kinematics by modelling movement. The idea was that many of the problems that students encounter with these topics have their origin in the traditional transfer method of education. Alternatives to the traditional transfer method stress the importance of modelling activities. In these alternatives two approaches are recognized: one uses simulations for exploratory modelling and the other uses (computer) tools for expressive modelling. In the expressive approach students have the opportunity to express the evolving concepts. This approach has many similarities with emergent modelling in realistic mathematics education and does also fit the discussion about the dialectic relation between symbolizing and understanding. Doorman investigated how these ideas can be implemented, how information technology supports expressive modelling and how students can learn calculus and kinematics in an integrated course in upper secondary education.

Gerwen, E van (2005). *"Praktische opdrachten"; welke invloed heeft de structuur van de praktische opdracht op het product, het proces en de beleving van de leerlingen? ['Practical tasks'; what effect does the structure of the practical tasks have on the product, the process and the attitudes of students?].* Masters Thesis. Groningen University.

In the Netherlands, a new element in mathematics education at senior secondary schools is the 'practical tasks'. It consists of a thematic inquiry by students, often carried out in groups and concluded by a report of students' findings. Van Gerwen studied whether students were able to apply prior knowledge and how the structuring of the tasks (either more scaffolded or more open) and students' report on their collaboration processes had effects on students' products, processes, and attitudes. She had 'practical tasks' of applied mathematics for three different target groups (all from general secondary school). For the grade 10 Humanities stream there was a task on applying probability to a quiz game. For the grade 10 Sciences stream there was a calculus task on optimizing a box for packaging. For the grade 9 mixed stream there was a task on statistics. All tasks corresponded with mathematical concepts of lessons recently taught before. Two tasks were created in two versions, one more scaffolded and the other more openly structured. Data were obtained

through classroom observations, a questionnaire, students' self-report on their collaboration, interviews with the teachers and final marks of students' products (posters).

Results showed that students had a lower level of mathematical knowledge than anticipated and many of them were not well able to activate it for the tasks. Because the teacher and the researcher had to assist the groups on numerous occasions, the difference between the more or less structured tasks could not be well measured. Nevertheless, there was one interesting result: in the sub-group of the students from the grade 10 Sciences stream, the quality of their work was higher with the more openly structured format. Students reported that they enjoyed the group collaboration and the application of the concepts taught before, but it could not be established whether the self-reports had created any effect.

Gulik-Gulikers, I. van (2005). ***Meetkunde opnieuw uitgevonden; een studie naar de waarde en toepassing van de geschiedenis van de meetkunde in het wiskundeonderwijs [Reinventing Geometry: a Study on the Value and Application of the History of Geometry into Mathematics Education].*** **PhD Thesis. Groningen University.**

This thesis discusses the value and the applicability of the history of geometry in contemporary mathematics education. Two experiments were organized then. Purpose of these design research projects was to find out what effect lessons on the history of geometry may have on motivation and cognition.

The first experiment focused on the profession of the 17th century Dutch surveyor. Through lesson materials with authentic historical resources, grade 8-9 students were introduced to techniques to measure the height of a tower or width of a river. On the basis of these problems with a historical bias a practical assignment was developed in which pupils had to develop strategies to calculate the height of a building.

The materials were tested in 46 classes with 1100 students at 16 schools. Through questionnaires, observations, tests and interviews with selected students the researcher found that, in general, motivation for and cognition in mathematics did not increase through the use of historical contexts. The use of authentic texts in the original 17th century annoyed many students, but the practical assignment received positive comments.

The second study focused on the history of non-Euclidean geometry and had as a target group the highest grades of pre-university students in the natural sciences stream. The materials replaced the topic of 'proofs in plane geometry' and were tested at 8 schools. On the basis of texts and assignments students familiarise themselves with hyperbolic geometry and examine the results with the aid of the computer.

The reinvention of the basic assumptions of geometry results in a more lively learning process and a better motivation. In this way pupils do indeed gain a deeper insight into the origin of geometry.

The thesis is concluded with recommendations. For teachers, the availability of additional historical resources proved crucial for incorporating historical themes.

Jensen, T. J. (2007). ***Developing mathematical modelling competency as the hub of mathematics education – why not?*** **[In Danish] PhD Dissertation. Supervisor: Prof. Mogens Niss, Roskilde University.**

This dissertation – published as IMFUFA-text 458 (imfufa@ruc.dk) – is one of the results from a combined research and developmental project within the area of mathematics education. The project has consisted of making a systematic enquiry structured around the question: *Why is mathematical modelling not the hub of mathematics education?*

The enquiry started with an analysis of what is potentially achievable by putting great emphasis on mathematical modelling in the teaching of mathematics. This was followed by an analysis of some aspects central to the planning of such teaching. These points of orientation were used as the basis to attempt having a class in the general gymnasium – upper secondary school – carry out a two year mathematics teaching programme with mathematical modelling as the hub. This programme was then analysed with the aim of identifying what has been possible and what have been the important hindrances at all levels.

This structure is motivated and elaborated in part I, which ends with a combination of the formulated research questions and a synopsis. These are reproduced here to present the structure of the enquiry and of the dissertation. The first two research questions were:
a) What *potentials* of working with analysis and construction of mathematical models in general education with a mathematical content can I argue for the existence of, based on analyses from the perspective of mathematics as a teaching subject and cognitive psychology?
b) What meaning can I ascribe to the concepts: mathematical modelling, mathematical problem solving, competence, mathematical modelling competency, mathematical problem tackling competency, technological competency and democratic competency, to make them a constructive tool with respect to the identified potentials in relation to thinking about and planning, carrying out and evaluating general education with a mathematical content?
In part II I argue for the existence of two kinds of potentials: From a justificational perspective these have to do with an ability to make significant contributions to the development of the pupils' technological and democratic competencies. In both cases the potential is graded according to how active the pupils are in taking part in the aspects of mathematical modelling having to do with delimitation and critical evaluation, which motivates a conceptual understanding emphasising these aspects of the mathematical modelling process.
From a cognitive-psychological perspective the potential lies in developing the pupils relational understanding by creating connections between applicational experiences and the mathematical concept structures in play. The possibility of fulfilling this potential is graded according to how much the pupils are involved in application oriented mathematical problem solving as part of their work with mathematical modelling, which motivates a certain understanding of what mathematical problem solving means.
The third research question was:
c) What organisational characteristics of the way mathematical modelling can potentially be integrated into the teaching can I defend as being central, based on theoretical analyses, if the goal is to develop the pupils' mathematical modelling competence as much as possible?
In part III I draw up four organisational anchor positions: 1) Mathematical modelling practised as *participant directed problem oriented project work* must be a recurrent activity in the teaching. 2) The general guidelines for the carrying out of the teaching as regards the content must consist of a crossing of a characterisation of a number of *subject specific competencies* and overall *subject areas*. 3) The didactical contract in the non-project organised parts of the teaching must – to put briefly – have development of the pupils' mathematical problem tackling competence as the hub, and a considerable part of the problems to work with must involve *mathematisation*. 4) A *harmony between what is valued in the teaching and in the summative assessment* must be ensured. Here in the dissertation I have delimited myself only to defend the first three positions by means of a proper analysis.
The final research question was:
d) What are the nature of the *hindrances* that in a specific case stand in the way of the Utopia of a complete realisation of good practice in accordance with the central organisational characteristics?
Referring to all the preceding theoretical studies, part IV contains a description of the course of *a specific experimental project*, where a class of 25 pupils and a teacher in the general gymnasium carried through the two-year course to B-level in mathematics based on an experimental curriculum made for the occasion. Parallel to the description, a list of *successful elements* with respect to the established ideals are pointed out, and subsequently four *hindering matters* are brought to light: Time management, limitations in the resources of the teacher, difficulties of making participant directed teaching possible and matters relating to the final written exam. Part V closes the dissertation by putting forward a number of prospective reflections and suggestions aimed at research as well as practice within mathematics education.

Kok, R. (2007). ***Correlatie en regressie. [Correlation and regression in pre-university mathematics education].*** **Masters Thesis. Utrecht University. Available from http://www.fi.uu.nl/~arjanz/home.htm .**

A design-based research on teaching 'correlation and regression' as part of the newly implemented mathematics curriculum for the science and technology stream at pre-university level.

Löhner, S. (2005). *Computer based modeling tasks: The role of external representation.* PhD Thesis. University of Amsterdam.

Löhner studied how different representations of mathematical models can affect students' learning. She used a computer simulation tool for modelling and brought grade 9 students into two conditions: either the mathematical models were represented as equations or as graphics (a network of boxes with variables and arrows displaying the relationships). She then compared the quality of the models and students' reasoning on the relationships between variables. Results were that in both conditions, the quality of the models was low. However, students in the graphing condition built more complex models but gave fewer causal explanations of the simulated outcomes. Therefore, Löhner recommends a mixed condition for future instructional environments. In the micro-analysis of students' actions, she observed that students do not pursue a systematic or cyclic modelling approach, but build a model by trial-and-error. In a second experiment, Löhner studied how 'running a simulation' (generating a graph of the output) assisted students in predicting outcomes and explaining relations. She brought students into two conditions: either the students could 'run their model' or they only had a causal diagram. Results were that students' reasoning in both conditions was weak, in particular on explaining causal relationships. Students in the Running condition could better predict outcomes, while students in the Causal condition had a better factual knowledge of the variables. Limitations of both studies were, that students were unfamiliar with the simulation tool and that they were inexperienced modellers. Löhner recommends designing a modelling curriculum, either by scaffolding the modelling tasks or by gradually increasing the complexity of the models.

Nguy□n Thanh Th□y (2005). *Learning to teach Realistic Mathematics in Vietnam.* PhD Thesis. University of Amsterdam.

In Vietnam, mathematics is taught as a purely abstract subject through the memorization of rules in a teacher-centered setting. In this environment, Nguy□n undertook an action research based on Marzano's DoL (Dimensions of Learning) and the use of application tasks as a starting point in mathematics. To exemplify the approach of Realistic Mathematics Education, she introduced a modelling task to her students in the mathematics teacher training program. The task consisted of optimizing the sale of coconut candies at the Vietnamese New Year festival. In consecutive courses she frequently discussed principles of DoL and RME with the students. Thereafter, she collected data from a small sample of students on the take-up of these principles during micro-teaching courses and during their teaching practice. With all student-teachers struggling with their initial teaching experiences, almost all students embraced DoL. Only one student teacher saw advantages in the use of contexts in mathematics education and he designed his own modelling task. The study contributes to understanding the teaching and learning of realistic mathematics in developing countries.

Pijls, M. (2007). *Collaborative mathematical investigations with the computer: Learning materials and teacher help*. PhD Thesis. University of Amsterdam.

The purpose of this study was to investigate how investigation tasks, collaboration in pairs and the use of computer simulations can foster mathematical level raising for grade 10 students. Based on the Van Hiele levels, Pijls defined a perceptual level and a conceptual level. The transition between these was termed as *level raising*. The students worked in pairs with a game tool in which a ball falls through a Galton board and one of the endpoints has a jackpot. Students were asked to model the game and calculate the probability of winning. The games were linked to the topic of 'Routes and Probabilities' in their textbook, from which they worked in the same pair. Pijls conducted two studies. In the first study, three groups of students under different conditions were compared in a pretest-posttest experiment during a series of ten lessons: using the computer *before, during* or *after* the learning of the concept. There was no significant difference in the attained conceptual level on the posttest. Students in the *during* condition, however, showed more often a beginning with level raising during the lessons, while students in the *after* condition used more often concepts which they did not really understand.

In the second study, Pijls studied students in the *during* condition under different conditions: with either a teacher only offering *process help* (encouraging interaction) or only *product help* (offering mathematical concepts). There was no significant difference in the attained conceptual level. Both studies give indications that investigation tasks prevent students from 'meaninglessly learning a trick'.

When teachers refrain from providing the concepts, students learn to develop their own mathematical ideas.

Rassul Pinto, A.A. (2002). *Exploração de materiais instrucionais produzidos com base em artigos de jornais para o ensino da estatística [Exploring the potentials of locally produced artcraft objects in teaching secondary school geometry in Mozambique].* Unpublished M.Ed. Thesis. Maputo, Mozambique: University Eduardo Mondlane. Supervisor: Pauline Vos.

In this study, authentic resources were used as a starting point for mathematics, whereby *authenticity* was defined as 'clearly not produced for educational purposes'. The study designed a new Statistics course for undergraduate students in the Social Sciences starting from authentic newspaper clippings. The design was based on design principles such as the avoidance of whole-class lecturing, an inductive approach starting from real-life problems, and the enhancement of discussion among students. Only after collecting newspaper articles, statistical concepts were chosen. In the construction stage, four selected themes were elaborated for an eight-week course (suicide; domestic violence; employment policies of the Mozambican railway company; the price of maize). The first prototype worksheets were revised after an expert appraisal (with a subject specialist, an instructional specialist).

The materials were tested with n = 60 students in the Social Sciences, in a second year Statistics course. The intervention consisted of a one-group pretest-posttest design for measuring change. For the pre- and posttest, an instrument was used based on Aiken and Dreger's mathematics attitude test, as validated by Brito (1998), and adapted for statistics by Cazorla et al. (1999). The test had three scales: *beliefs*, *affect* and *composure*. Triangulation was established with additional data from classroom observations (field notes) and four semi-structured student interviews (audio-taped and transcribed).

Results from the attitude tests can be summarized as follows: already in the pretest, students indicated to like Statistics, despite observed anxiety. Probably, the students gave *socially expected answers*. Consequently, the difference between pretest and posttest was insignificant. However, the qualitative data from observations and interviews offered additional insights. These data revealed that the students were happily surprised with (a) the possibility to discuss during the lectures, (b) the inclusion of everyday newspaper articles in a statistics course, and (c) to see statistics linked to their disciplines of study (sociology, politicology, antropology).

Sins, P.H.M. (2006). *Students' reasoning during computer-based scientific modeling*. PhD Thesis. University of Amsterdam.

[no abstract provided]

Zaal, A. (2007). *Speltheorie in wiskunde D. [Game theory in pre-university mathematics education]* Masters Thesis. Utrecht University. Available from http://www.fi.uu.nl/~arjanz/home.htm .

This thesis describes design-based research on teaching 'game theory' as part of a newly implemented mathematics curriculum for the science and technology stream at pre-university level.

8. Recent Publications of Interest

Andresen, M. (2007a). Introduction of a new construct: The conceptual tool 'flexibility'. *The Montana Mathematics Enthusiast,* 4(2), 230-250. [Available at http://www.montanamath.org/TMME/]

Andresen, M. (2007b). Modeling with the software 'Derive' to support a constructivist approach to teaching. *International Electronic Journal of Mathematics Education, 2* (1), 1-15. [Available at http://www.iejme.com]

Andresen, M. (2007c). *Understandings of 'modelling'.* 10 pages. CERME 5 (Fifth Conference of the European Society for Research in Mathematics Education), 22-26 february 2007, Larnaca, Cypern.

Brown, R., & Redmond, T. (2007). Collective argumentation and modelling mathematics practices outside the classroom. In J. Watson & K. Beswick (Eds.), *Mathematics: Essential research, essential practice*. (Proceedings of the 30th annual conference of the Mathematics Research Group of Australasia (MERGA), Vol. 1, pp. 163-171). Adelaide: MERGA. [Available at www.merga.net.au/publications/]

Diefes-Dux, H. A., Hjalmarson, M., Bowman, K. & Zawojewski, J. S. (2006). Quantifying aluminum crystal size Part 1: The model-eliciting activity. *Journal of STEM Education, 7*(1&2), 51-63.

Dekker, T., Lagerwaard, K., de Lange, J., Limpens, G. & Wijers, M. (2006). *Wiskundige geletterdheid volgens Pisa; hoe staat de vlag erbij? Volume 1: Analyse. Volume 2:Opgaven [Mathematical literacy according to Pisa; which way does the wind blow? Volume 1: Analysis.Volume 2: Tasks].* Utrecht, NL: Freudenthal Institute, Utrecht University.

Doyle, K. (2007). The teacher, the tasks: Their role in students' mathematical literacy. In J. Watson & K. Beswick (Eds.), *Mathematics: Essential research, essential practice*. (Proceedings of the 30th annual conference of the Mathematics Research Group of Australasia (MERGA), Vol. 1, pp. 246-254). Adelaide: MERGA. [Available at www.merga.net.au/publications/]

English, L. (2007). Complex systems in the elementary and middle school mathematics curriculum: A focus on modeling. In B. Sriraman (Ed.), *Festschrift in honor of Günter Törner's 60th birthday [The Montana Mathematics Enthusiast Monograph No.3*] (pp. 139-156). [Available at http://www.montanamath.org/TMME/

English, L. D. (2007). Interdisciplinary modelling in the primary mathematics curriculum. In J. Watson & K. Beswick (Eds.), *Mathematics: Essential research, essential practice*. (Proceedings of the 30th annual conference of the Mathematics Research Group of Australasia (MERGA), Vol. 1, pp. 275-284). Adelaide: MERGA. [Available at www.merga.net.au/publications/]

Hjalmarson, M. A., Diefes-Dux, H. A., Bowman, K., & Zawojewski, J. S. (2006). Quantifying aluminum crystal size Part 2: The model-development sequence. *Journal of STEM Education, 7*(1&2), 64-73.

Henn, W-H. (2007). Modelling in school: Chances and obstacles. In B. Sriraman (Ed.), *Festschrift in honor of Günter Törner's 60th birthday [The Montana Mathematics Enthusiast Monograph No.3*] (pp. 125-138). [Available at http://www.montanamath.org/TMME/]

Heuvel-Panhuizen, M. van den & Wijers, M.M. (2005). Mathematics standards and curricula in the Netherlands. *Zentrallblatt für Didaktik der Mathematik,* 37(4), pp. 287-307.

This paper addresses the question of what mathematics Dutch students should learn according to the standards as established by the Dutch Ministry of Education. The focus is on primary school and the foundation phase of secondary school. This means that the paper covers the range from kindergarten to grade 8 (4-14 years olds). Apart from giving an overview of the standards, we also discuss the standards' nature and history. Furthermore, we look at textbooks and examination programs that in the Netherlands both have a key role in determining the intended mathematics curriculum. In addition to addressing the mathematical content, we also pay attention to the way mathematics is taught. The domain-specific education theory that forms the basis for the Dutch approach to teaching mathematics is called *Realistic Mathematics Education*. Achievement scores of Dutch students from national and international tests complete this paper. These scores reveal what the standards bring us in terms of students' mathematical understanding. In addition to informing an international audience about the Dutch standards and curricula, we include some critical reflections on them.

Jurdak, M. (2008). The action map as a tool for assessing situated mathematical problem solving performance. *The Montana Mathematical Enthusiast, 5*(1), 67-78. [Available at http://www.montanamath.org/TMME/ or http://www.infoagepub .com/products/journals/TMME/]

Mousoulides, N., Sriraman, B., & Christou, C. (2007). From problem solving to modeling: The emergence of models and modeling perspectives. *Nordic Studies in Mathematics Education, 12*(1), 23-47.

Mudaly, V. (2007). Can our learners model in mathematics? *The Montana Mathematical Enthusiast, 4*(1), 93-102. [Available at http://www.montanamath.org/TMME/

Palm, T. (2006). Word problems as simulation of real-world situations: A proposed frameworks. *For the Learning of Mathematics, 26*(1), 42-47.

Staats, S. (2007). Dynamic contexts and imagined worlds: An interdisciplinary approach to mathematics applications. *For the Learning of Mathematics, 27*(1), 4-9.

Steinthorsdottir, O. B., & Sriraman, B. (2007). Gender and strategy use in proportional situations: An Icelandic study. *Nordic Studies in Mathematics Education, 12*(3).

Stocker, D. (2006). Re-thinking real-world mathematics. *For the Learning of Mathematics, 26*(2), 29.

Warick, J. (2007). Some reflections on the teaching of mathematical modelling. *The Mathematics Educator, 17*(1), 32-41.

Wijers, M., Jonker, V. & Kemme, S. (2004). Authentieke contexten in wiskundemethoden in het vmbo [Authentic contexts in mathematics textbooks for the vocational stream]. *Tijdschrift voor Didactiek der Bètawetenschappen*, 22(1), 1-19.